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ADULT CADDISFLY (TRICHOPTERA) PHENOLOGY IN TWO COLD-DESERT ENDORHEIC SPRING-STREAMS IN WASHINGTON STATE

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Abstract.—The species diversity and phenology of adult caddisflies was studied for two springs in the cold desert physiographic province of Eastern Washington State. During 1998 and 1999, adult caddisflies were collected using two light trapping methods: active collection using a mercury vapor light and passive collection using an ultraviolet light (UV). This study revealed a suprisingly diverse adult caddisfly fauna comprising eight families, 18 genera, and 26 species, with nine of the species collected being new distribution records of the State of Washington. Two species revealed significant range extensions with the closest records being from Utah.

Key Words.—Insecta, Trichoptera, Caddisflies, phenology, Washington, Springs.

Our goal was to describe the species diversity and phenology of adult caddisflies from two spring-streams in the cold desert physiographic province of Eastern Washington State. This area consists of semi-arid shrub-steppe habitat (Daubenmire 1970) and contains numerous springs. The most prominent water body is the nearby Columbia River. Shrub-steppe habitat is typically dominated by big sagebrush (*Artemisia tridentata* Nutt.), and Sandberg's bluegrass (*Poa sandbergii* Vasey). Range fires and exotic plant species have altered the native vegetation diversity (PNNL 1998).

In arid areas, spring-streams have been the focal point of human habitation. Permanent human habitation ceased on Hanford in 1943 when the site was acquired by the U.S. government. Some cattle and wild horses heavily utilized the spring-streams and riparian habitat near the study sites until 1961 (Rickard and Cushing 1982). Currently a large elk herd utilizes the spring-streams causing some damage to riparian and emergent vegetation.

The Trichoptera fauna of Washington State has not been summarized in recent times. The last comprehensive treatment of Washington Trichoptera distribution was by Davis (1948).

The two largest spring-streams on the Hanford Site (Fig. 1), Snively and Rattlesnake Springs, have been studied since 1972, beginning with productivity studies (Wolf and Cushing 1972), followed by insect food habits (Cushing and Rader 1982), primary production (Cushing and Wolf 1982, 1984), secondary production (Gaines 1987a, b; Gaines et al. 1992), trophic relations (Gaines et al. 1989), and organic carbon utilization (Mize 1993). Many of these studies included a description of the benthic aquatic insect fauna. Frest and Johannes (1993) surveyed the mollusks of Hanford and Newell (1998) surveyed the entire macroinvertebrate fauna of the two spring-streams. Cushing and Gaines (1989) theorized various recolonization routes for aquatic insects following routine spates that devastated

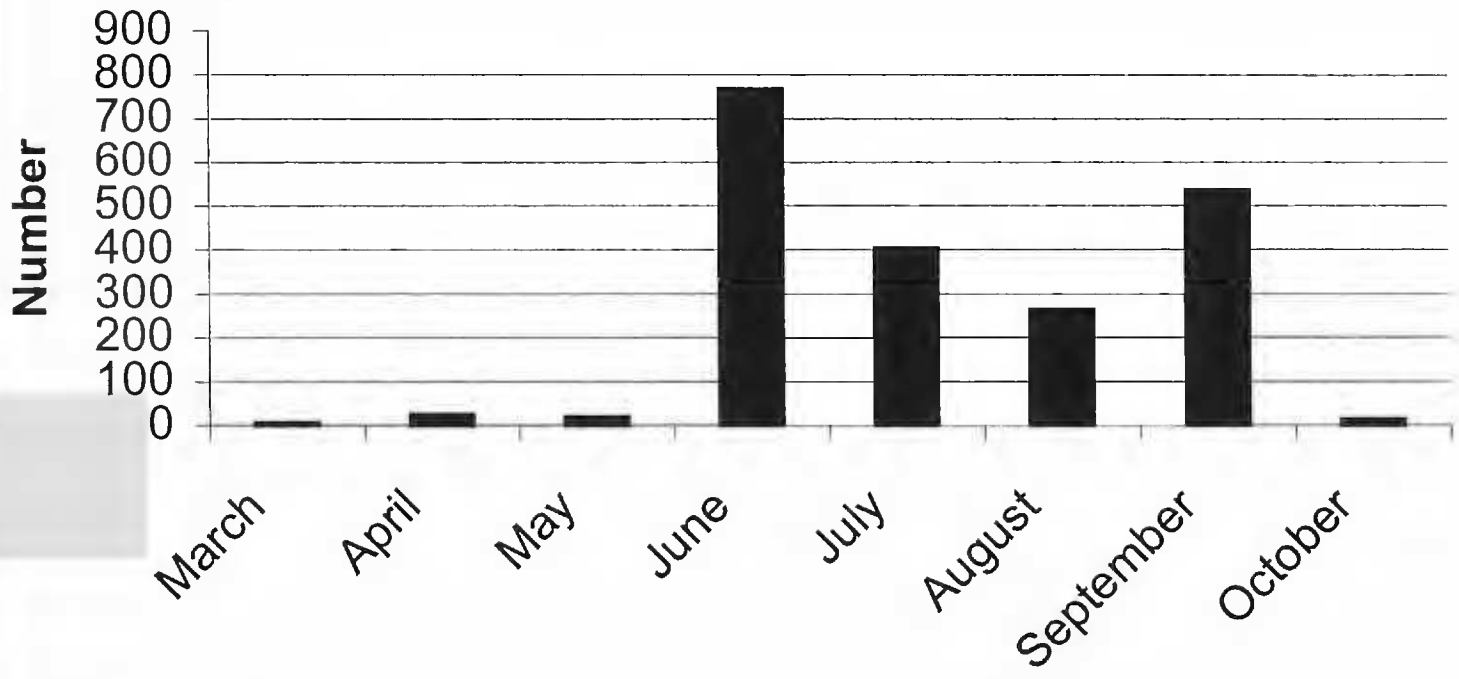

Figure 1. Total number of adult caddisflies captured each month at both spring streams.

the spring-streams. These two springs have been thoroughly studied for nearly 30 years with the major emphasis on the benthic insect fauna.

Study Area

The study site is located in northern Benton County, Washington, on the U.S. Department of Energy's Hanford site. The Hanford site occupies an area of about 1450 km^2 (PNNL 1998). The Hanford site is bisected north south by state highway 240. The land west of this highway (304 km^2) is called the Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE) under management of the U.S. Fish and Wildlife Service. The ALE has less human use than other portions of Hanford. Public access has been denied since 1943 (PNNL 1998).

Rattlesnake (46°30.48′ N, 119°41.96′ W) and Snively (46°27.53′ N, 119°43.30′ W) Springs are permanent spring-fed streams located about 32 km north of Richland, Washington. Rattlesnake Spring arises from seeps and flows for about 2.5–3.5 km before disappearing into the ground. Annual baseflow is about 0.01 m^3/sec and water temperature ranges from 2° to 22° C (PNNL 1998). Winter spates occur periodically in the 350 km^2 catchment basin but have not been measured. During these spates, stream width can increase from one m to 15 m, devastating the riparian vegetation and the aquatic fauna (Cushing and Gaines 1989).

Snively Spring originates from seeps about five km south of Rattlesnake Spring and the stream flows for about 3.6 km before sinking into the ground approximately one km west of Rattlesnake Spring. Schwab et al. (1979) estimated discharge at 0.0022 to 0.0031 m^3/sec, and Gaines (1987a, b) estimated discharge at 0.02 m^3/sec to 0.05 m^3/sec. Water temperature ranged from 3° to 19° C.

Dense riparian vegetation lining both streams, is comprised of bulrush (*Schoenoplectus* = *Scirpus* sp.), spike rush (*Eleocharis* sp.), cattail (*Typha latifolia* L.), wild rose (*Rosa* sp.), wild clematis (*Clematis ligusticifolia* (Nutt.)), peachleaf willow (*Salix amygdaloides* Anders.), stinging nettles (*Urtica dioica* L.), and other species. Some cottonwood trees are found along Rattlesnake Spring (*Populus trichocarpa* (T & G)) (Saskschewsky et al. 1992). Both streams have a heavy

Table 1. Diversity and combined abundance of individual caddis adults captured during 1998 and 1999 at both spring-streams.

Family/genus	Species	Number	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
Hydroptilidae										
Hydroptila	*argosa* Ross	50				●	●		●	
**Hydroptila*	*modica* Mosely	2							●	
Leucotrichia	*pictipes* (Banks)	1						●		
Glossosomatidae										
**Culoptila*	*cantha* (Ross)	61					●	●	●	
Glossosoma	*velonum* Ross	18				●			●	
**Protoptila*	*erotica* Ross	21				●		●	●	
Psychomyiidae										
**Psychomyia*	*flavida* Hagen	26				●	●		●	
Hydropsyche										
Cheumatopsyche	*campyla* Ross	908			●	●	●	●	●	
Hydropsyche	*californica* Banks	449			●	●	●	●	●	
Hydropsyche	*cockerelli* Banks	74		●	●	●	●	●	●	
Parapsyche	*almota* Ross	5							●	
Brachycentridae										
**Amiocentrus*	*aspilus* (Ross)	1			●					
Lepidostomatidae										
Lepidostoma	*cinereum* (Banks)	24		●			●		●	
Limnephilidae										
Hesperophylax	*designatus* (Walker)	11	●	●					●	
**Limnephilus*	*abbreviatus* Banks	1		●						
**Limnephilus*	*assimilis* (Banks)	3		●	●					
Limnephilus	*frijole* Ross	2							●	
Limnephilus	*sitchenssi* (Kalenati)	1		●						
Limnephilus	*spinatus* Banks	68							●	●
Leptoceridae										
Ceraclea	*latahensis* (Smith, SD)	2						●	●	
Nectopsyche	Species	6				●	●		●	
**Oecetis*	*avara* (Banks)	68				●		●	●	
**Oecetis*	*immobilis* (Hagen)	2			●				●	
**Oecetis*	*inconspicua* (Walker)	1						●		
Triaenodes	*tardus* Milne	17						●	●	
**Ylodes*	*frontalis* (Banks)	314		●	●	●	●	●	●	

growth of watercress (*Rorippa nasturtium-aquaticum* (L.) Schinz & Thell.), duckweed (*Lemna minor* L.), and species of filamentous algae in lentic areas.

Methods and Materials

Adult caddisflies were collected using two light trapping methods: 1) active collection using a mercury vapor light; and, 2) passive collection using an ultraviolet light (UV). Both light systems were available from BioQuip Products, Gardena, California. Taxa were sampled during 1998 and 1999, from March through November. Sampling was performed on an approximate biweekly basis.

The mercury vapor light method involved a 150-watt lamp suspended at about

Table 2. Total number and percentage of caddis adults captured by Family from both springs with percent of total.

FAMILY	NUMBER				Total	% of Total
	Rattlesnake Spr.		Snively Spr.			
Hydropsychidae	1094	63%	242	89%	1336	66%
Leptoceridae	370	21	13	5	383	19
Glossosomatidae	98	6	4	2	102	5
Limnephilidae	88	5	2	<1	90	4
Hydroptilidae	47	3	6	2	53	3
Psychomyiidae	22	1	4	2	26	1
Lepidostomatidae	24	1	0		24	1
Brachycentridae	1	<1	0		1	<1
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three feet above two white fabric sheets spread on the ground. Caddisflies landing on the sheets were captured and placed in alcohol. When the number of specimens coming to the light was small (less than about 50) all specimens were taken. When the number was much greater, at the end of the collecting period (approximately two hours after sunset) the sheets were rolled up with the specimens inside and frozen. The material on the sheets was later sorted and all specimens were retrieved, but this complete retrieval method was not employed until 1999.

The ultraviolet light method employed a bucket trap with four vanes around an 18-inch 15-watt UV light held vertically above the bucket. A funnel on top of the bucket prevented the captured specimens from escaping. At the end of the collection time (about two hours after sunset), the caddisfly specimens in the bucket were removed and placed in alcohol. When large numbers of insects were in the traps, the contents were transferred to plastic bags, frozen, and then sorted to retrieve all caddisflies. The complete retrieval method for UV light trapping was not employed until 1999.

Voucher specimens of the taxa collected are in the Richard E. Fitzner Natural History Collection at Washington State University Tri-Cities branch at Richland, Washington.

Results

This study revealed a surprisingly diverse adult caddisfly fauna comprising eight families, 18 genera, and 26 species (Table 1). Only one genus, *Nectopsyche,* did not reveal a male adult, negating a species identification. Previous benthic studies (Gaines 1987a, b; Gaines et al. 1989, 1992; Newell 1998) revealed only two families and four genera.

The greatest numbers of adults were captured in June (766), and the smallest number in March (4) (Fig. 1). The Hydropsychidae comprised 66% of all adults (Table 2). The Family Brachycentridae was represented by a single specimen. *Cheumatopsyche campyla* adults comprised nearly half of all adults (45%) (Table 3). Approximately 54% of the adults were females and 46% were males.

Three of the top four most abundant species (*Cheumatopsyche campyla, Hydropsyche californica,* and *H. cockerelli*) (Table 3) are also abundant in the Columbia River, just 20 km away (Newell 1998). Other species present in the Co-

Table 3. The six most abundant species collected at the two spring streams, percent of total number collected, and peak emergence period.

SPECIES	Number	% of Total	Emergence Peak
Cheumatopsyche campyla	908	45%	Last half of June to early July
Hydropsyche californica	349	17	Last half of June
Ylodes frontalis	287	14	Last half of August through September
Hydropsyche cockerelli	74	4	First half of August
Limnephilus spinatus	68	3	Second half of September
Oecetis avara	68	3	Last half of June

lumbia River and at least one of the spring streams are: *Glossosoma velonum, Hydroptila argosa,* and *Psychomyia flavida.* Unidentified species of the following genera are also known from the Columbia River: *Nectopsyche* sp., and *Oecetis* sp. The terrain between the Columbia River and the springs is relatively flat and this area has frequent high winds. The records of only four larval genera in over 15 years of benthic sampling in the two springs compared to the large number of genera collected during this study suggests many species originated in the nearby river.

The fauna of the spring streams consists of species primarily eastern and southern United States in distribution. Nine of the 26 species collected appear to be new distribution records of the state. These new records are marked with an asterisk (*) in Table 1. While most of these new records are expected, the collections of *Limnephilus abbreviatus* and *L. assimilis* are significant range extensions as the closest records appear to be from Utah.

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